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The following examples are presented comparatively, in order that the meeting may judge of the merits of the new method:—

To find the product of 53·684 × 45·678.

By the Tables.	By the Common Method.	By Logarithms.
s. 99362, T_s=2468201761	53·684	λ2·7298449
d. 8006, T_d= 16024009	45·678	λ2·6597071
2452·177752	429472′	5·3895520
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	322104	138
	268420	124= 7
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Abstract of a Paper on the Progressive Rates of Mortality, as occurring in all Ages, and on certain Deviations; also on Dr. Buchanan's "Physiological Law of Mortality." By JOHN REID, *Surgeon, Glasgow, Author of "The Philosophy of Death."*

[Read before the Institute of Actuaries, 28th January, 1856, and ordered by the Council to be printed in abstract.]

THE progressive rates of mortality, from birth to extreme old age, in a given number of any population, are known from the proportionate numbers who die at the different ages. This is the only mode of estimating correctly the expectation or conceived "*security*" of life at any given age—viz., by showing the chance which an individual has of living a certain number of years or shorter periods.

There is no general law of mortality arising from the physiological functions of the animal system, excepting that resulting from the limit to structural endurance: an organ may be destroyed in the first week of life, from some excited disease, which, apart from that, might have remained entire, say to the age of one hundred years. Disease is only an accidental occurrence to an individual; for even the fact of 3,900 children dying the first five years, out of 10,000 born, only shows that all those children have become accidentally diseased or have otherwise met with their death. But it may be said, that such a great proportion dying in infancy and early childhood must be owing to a vital or physiological cause; or, in other words, that those who have died in early life must have been prone to disease. Such an inference is not admissible, because, if a child live for any length of time apparently in a healthy state, it must be presumed that that child was born with its vital organs in a fit state for living.

The table in Dr. Buchanan's paper on the "Physiological law of mortality," read to the British Association at Glasgow in 1855, shows the number of deaths in 100 living at the different ages—*e.g.*, at the age of one year, out of 100 *born*, 14·631 die; and at the age of one hundred and six, of 100 living the whole die. But such calculations, based upon the fact of those numbers dying in one year out of 100 who have reached those ages, only shows the actual mortality of these particular hundreds: at the age of one year we may have 14·631 deaths out of the small number 100 born, but it requires 10,000 to be born to give 100 deaths at the age of one hundred and six years; consequently such a mode of estimating the "law of mortality" is entirely fallacious, because the small chance of surviving to the extreme age of one hundred and six years is as 100 is to 10,000.

Referring to the per-centages of deaths represented in the two first five-year periods of life, we find the mortality more than one third of the whole. This rate has been considered too high; but the present registration returns for some of the large towns of Scotland show a proportion of deaths still higher, being in Greenock at least 50 per cent. during the first five years of existence. During the second five years the general rate of mortality falls to 4½ per cent., which places the child beyond the most critical period of life—that period when it is almost altogether restrained from its own instinctive actions, and consequently deprived of the salutary exercise necessary for the healthful performance of its organic functions. Compare the amount of death in these periods with that of the lower animals—say in their first year, that being their early and mature infancy—and we feel quite at a loss to account for the disparity of deaths. Only a very small per-centage of the domestic animals die from *natural causes* in early life; so if we had, as Dr. Buchanan alleges, in every child at birth "the elements of its own decay," and that also "in every organism, animal and vegetable," how comes it that the deaths, both in early animal and vegetable life, are the exceptions only to the fair chance of all surviving? A child or animal born, and a plant springing, perfect in their parts and consequently healthy, do not contain within themselves any elements of decay, more than what may be excited in their organisms from extraneous causes. A child or young animal is improperly fed, or perhaps injudiciously exposed; its functions—first the organic, then the animal—become deranged, causing disease from which it dies: there is no "natural decay" in such a case, no more than in the death of a plant caused by worms at its root, or as blighted in its functional organs, either by its roots coming into contact with noxious agents in the soil, or by its leaves being morbidly affected by an ungenial state of the atmosphere. If Dr. Buchanan's "physiological law" were tenable in respect to "natural decay" being inherent, we ought to have the greatest mortality in early *embryonic life,* gradually decreasing to the time of birth; for if the organism be morbidly susceptible in infancy, it ought to be still more so *in embryo:* but facts prove that nature, *per se,* works well, *intra uterine* death being comparatively rare; and, that death either in embryo, infancy, childhood, or in the mature periods of life, arises from *excited* disease, and not from "natural decay." But in extreme old age many individuals die from an exhausted or worn-out state of the system, without any symptoms of specific disease. Such a condition may be termed natural decay: but still the functional parts have only become changed in their relative influences, the absorbents having consumed more than the falling-off assimilative organic depositories could compensate for; or, in other words, the combustion being greater than the assimilated products as fuel could keep up, the flame of life is extinguished.

According to Dr. Buchanan's views, we have a "normal course of mortality as affected by age alone," which implies that every age produces its own rate of mortality. If such be the fact, how is it that of some very large families none have died till an advanced period of life? and also, that in some districts of country, compared with others, a greater number in every condition of life attain to an advanced age?

In tracing all the causes of death to their *exciting* cause, we unfold the proof as to the one being an effect of the other, from physiological or organic action having been deranged; but it is certainly no physiological law by which twenty children may die from the diseases generally occurring during teething, out of one hundred born, when perhaps not five may die out of another hundred: it might not be impossible to rear, under judicious nursing and management, even the whole of one hundred born! In many of our higher families, children's severe diseases are scarcely known; the mortality under such circumstances is consequently small. Where is the evidence of a general physiological law of mortality, under such immunity from premature death?

Amongst the higher and middle classes the rate of mortality is small, from twenty-five to fifty-five, whilst the average rate during these ages among the mass of the people is much greater; this fact again sets aside the physiological law, and compels us to trace the causes of death to their circumstantial origin.

A child at birth cannot contain the elements of its own decay, else every child would die because of the presence of those elements; which is contrary to the fact. Life never comes to a "spontaneous termination," excepting, as mentioned above, in some cases of extreme old age, death being the result either of violence, or of organic disease directly or indirectly excited in some organ. According to Dr. Buchanan, every child is born imperfect in so far as its physiological condition tends to derangement of its system—the head is too large, or there is an "unequal development of other organs": reasoning by analogy, the same may be inferred in respect to the lower animals. Colts are born with a large head and long legs, yet they are perfect of their kind; a child is born with a large head in proportion to its body—it has therefore within itself "the elements of its own decay"! How the mortality of early infancy "is exactly similar in kind to the mortality (if that name can be applied to the destruction) of embryonic life," is difficult to imagine: in the embryonic state vitality exists by organic action, in ex-uterine life we have animal function superinduced; in the one state of being death takes place from the cessation of organic action, in the other from that also proximately, but remotely from derangement of animal function—excepting, perhaps, those cases originating in local morbid structural disease, but even in such cases there may have been primary functional derangement as the exciting and fostering cause. By the theory of Dr. Buchanan we should have death occurring in a regular "normal" ratio, *without* any "conspiring" or "disturbing" causes; a high rate of mortality in early life, gradually decreasing; a similar excess in advanced life, but gradually increasing, and a comparatively low rate in the intermediate period: in the lower animals the reverse is the case—there being small mortality in early and great in mature life, from artificial causes. The mortality of the human race in infancy is great only from artificial causes: the lower animals treat their young in a natural way, therefore the mortality is small; and if they were not interfered with in maturity such would also be the case, the rate of mortality gradually increasing with advanced age. So it ought to be in the human species, but for the "conspiring" causes; if the physiological laws of the system were let alone, we should have life in our race generally moving on to old age in the "even tenor of its way."

What Dr. Buchanan assumes as the physiological is in reality the accidental law of mortality, springing out of the civilized habits or circumstances of the people; which is proved by the fact figured in his third table, showing the rate of mortality at the age of twenty-three, amongst annuitants, of 100 living at that age, to be 1·507, whilst the "*average*" of all living at the age of twenty-four is only ·871, or little more than one half! I am inclined to think that Dr. Buchanan's first table, "*computed from a table of a different form,*" represents a law of mortality at the different ages which any table, constructed upon the real rates of mortality at these different ages, would represent very differently.

There is no general law of mortality, affecting the different periods of life, which can be applied to the whole population of any country, for we find that the proportion at the different ages varies according to circumstances as affecting individuals: in towns the deaths in infancy and childhood are much more numerous than in the country, and such is the case also amongst the poorer classes compared with those in comfortable circumstances. From this fact alone it is evident that we must trace the causes of death in infancy and childhood, and indeed in every other period of life, to those physical and artificial agencies which derange the natural functions of the body, and so affect its physiological or organic actions; but there is no "physiological law," *per se,* which operates in cutting off one individual in infancy and another in old age: if such were the case, it would imply inherent organic imperfection. Now, unless in organic disease superinduced in organic structure from *excited* functional derangement, we have no proof that any organ becomes suddenly deranged in its action without some exciting cause, either operating directly or sympathetically on the organ affected.

Death, being always the result either of injury, disease, or extreme old age, cannot generally be ascribed to any physiological law; for, from the effects of injury or with the commencement of disease, *normal* physiological action ceases. There is, however, one *physical* law of mortality, viz., that no individual known, since the patriarchal ages, shall reach the age of two hundred years; so the period betwixt the birth and death of the oldest individual known would measure the range of that law, which, added to all the different cotemporaneous terms of life, might increase the mean term a unit in some millions! But, admitting many such deaths in extreme old age, from physiological action being worn out, how little would these contribute in establishing a general "physiological law of mortality," as against the great prevailing mortality arising from the accidental causes of death, springing from the circumstances and vicissitudes of life!

On the Origin and Progress of the Calculus of Probabilities. By SAMUEL BROWN, *Actuary of the Guardian Assurance Company, and a Vice-President of the Institute of Actuaries.*

[Read before the Institute, 25th February, 1856, and ordered by the Council to be printed.]

THE application of the doctrine of chances to questions connected with the money values of contingencies depending on human life is now become so common, in this and many other countries, that we may be apt to forget its origin and the process by which it arrived at its present degree of improvement. Although the history of this calculus may be well known to some members of this Institute, there may be others whose time is, perhaps, too occupied to allow of more than the mere study of the calculations and formulæ necessary for the daily routine of a Life Assurance Office, and who may not be aware of the number of other subjects to which, at an early period, the calculus of probabilities was suggested to be applied. I hope, therefore, that in taking a rapid glance at the changes and improvements effected since the first crude ideas on the subject, I may not only be able to excite an increased interest in the science, but induce a further extension of its usefulness.

Poisson remarks that a problem relative to games of chance, proposed to an austere Jansenist by a man of the world, was the origin of a branch of science, now one of the most important in its effects on society. It was in 1654 that the Chevalier de Méré applied to Pascal for a solution of two problems, for which he was unable to find answers. The one was, to ascertain in how many throws one might bet with advantage that two sixes would be